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Barry E. Bretschneider  
Morrison & Foerster LLP  
Suite 300  
1650 Tysons Boulevard  
McLean, VA 22102

EXAMINER
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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* JOHN TWYNAM

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Appeal 2009-0105  
Application 10/762,572  
Technology Center 2800

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Decided: January 9, 2009

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Before KENNETH W. HAIRSTON, JOSEPH F. RUGGIERO  
and MAHSHID D. SAADAT, *Administrative Patent Judges*.  
HAIRSTON, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. §§ 6(b) and 134 from the final rejection of claims 1 to 3 and 5 to 7.

The disclosed invention relates to a compound semiconductor FET that comprises an undoped AlN layer on a substrate, a plurality of III-N layers provided on the AlN layer, with the III-N layers including an undoped GaN layer, and an n-type delta doped GaN layer interposed between the

undoped AlN layer and the undoped GaN layer. The n-type delta doped GaN layer has a dopant concentration that reduces discontinuity of an electric field at the interface between the undoped AlN layer and the undoped GaN layer (Fig. 1; Spec. 4, 5, 7, 9, and 16).

Claim 1 is the only independent claim on appeal, and it reads as follows:

1. A compound semiconductor FET comprising:
  - an undoped AlN layer provided on a substrate;
  - a plurality of III-N layers provided on the AlN layer, the III-N layers including an undoped GaN layer;
  - an n-type delta doped GaN layer interposed between the undoped AlN layer and the undoped GaN layer, and having dopant concentration for reducing discontinuity of an electric field at an interface between the undoped AlN layer and the undoped GaN layer;
  - a source electrode;
  - a gate electrode; and
  - a drain electrode.

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Khan	US 5,192,987	Mar. 9, 1993
Abrokwah	US 5,895,929	Apr. 20, 1999
Inoue	US 6,639,255 B2	Oct. 28, 2003
Phillips	US 6,770,902 B2	Aug. 3, 2004 (filed Oct. 29, 2002)
Yamashita	US 6,995,397 B2	Feb. 7, 2006 (filed Jul. 14, 2003)

The Examiner rejected claims 1 and 2 under 35 U.S.C. § 103(a) based upon the teachings of Khan and Yamashita.

The Examiner rejected claim 3 under 35 U.S.C. § 103(a) based upon the teachings of Khan, Yamashita, and Phillips.

The Examiner rejected claims 5 and 6 under 35 U.S.C. § 103(a) based upon the teachings of Khan, Yamashita, and Inoue.

The Examiner rejected claim 7 under 35 U.S.C. § 103(a) based upon the teachings of Khan, Yamashita, and Abrokwhah.

In the obviousness rejection of claims 1 and 2, the Examiner indicates (Ans. 4) that Figure 5 of Khan describes all of the claimed compound semiconductor FET structure set forth in claim 1 with the exception of an n-type delta doped GaN layer interposed between an undoped AlN layer 38 and an undoped GaN layer 39. According to the Examiner (Ans. 4), “Yamashita discloses (see, for example, FIG. 1) a semiconductor device comprising a channel layer 20 wherein the channel layer comprises an n-type undoped layer 22, and an n-type delta doped layer 21,” and “[i]n column 23, lines 1-6, Yamashita discloses that GaN may be used.” In view of the teaching in the Abstract of Yamashita that the presence of the n-type delta doped layer 21 in the channel layer 20 weakens the electric field in the surface region of the channel layer to thereby allow the current drive force of the transistor to increase, the Examiner is of the opinion (Ans. 4) that “it would have been obvious to one of ordinary skill in the art at the time of invention to have an n-type delta doped GaN layer in order to increase the current drive force of the [Khan] transistor.”

Appellant argues (Reply Br. 3) that the skilled artisan would be motivated by the teachings of Yamashita “to include a high-concentration delta doped layer 21 in the deeper portion of a well layer, but not to provide an n-type delta doped GaN layer between an undoped AlN layer and an undoped GaN layer.” Appellant submits (Reply Br. 2) that “the Examiner is picking and choosing various elements of the cited references in an attempt to recreate the claimed invention in hindsight.”

As indicated *supra*, Khan describes all of the claimed compound semiconductor FET structure set forth in claim 1 with the exception of the n-type delta doped GaN layer interposed between the undoped AlN layer and the undoped GaN layer.

Yamashita uses a p-type silicon carbide (SiC) layer 10 at the bottom of epitaxial layer 9. Yamashita states (col. 1, ll. 12 to 14) that SiC “has a wide bandgap and high dielectric breakdown characteristics as compared with other semiconductor materials.” Yamashita further states (col. 23, ll. 1 to 5) that “[t]he wide bandgap semiconductors to which the present invention is applicable include semiconductors that have a wider bandgap than Si, such as GaN, AlGa<sub>N</sub>, AlN, GaAs, and AlGaAs, in addition to SiC.”

Although it may be possible to use GaN in Kahn based on the teachings of Yamashita, we agree with Appellant that the teachings of the applied references are completely silent as to use of a doped GaN layer at the particular spot chosen by Appellant in the disclosed and claimed invention. As noted by Appellant, such a spot can only be chosen based upon impermissible hindsight. Thus, the Examiner’s conclusion that it would have been obvious to the skilled artisan to interpose an n-type delta

doped GaN layer between the undoped AlN layer and the undoped GaN layer in Kahn is not supported by the teachings or suggestions of Yamashita.

In summary, the obviousness rejection of claims 1 and 2 is reversed because the Examiner's articulated reasons for combining the teachings of Yamashita with those of Kahn do not support a legal conclusion of obviousness. *KSR Int'l v. Teleflex, Inc.*, 127 S. Ct. 1727, 1741 (2007). The obviousness rejections of claims 3 and 5 to 7 are reversed because the teachings of Phillips, Inoue, and Abrokwhah do not cure the noted shortcomings in the teachings of Kahn and Yamashita.

The decision of the Examiner is reversed.

REVERSED

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Barry E. Bretschneider  
Morrison & Foerster, L.L.P.  
Suite 300  
1650 Tysons Boulevard  
McLean, VA 22102